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URINE TESTING

UP TO DATE.

A concise and comprehensive Manual of Urinary Analysis, including many tests not given in the standard text books.

DETROIT.

NELSON, BAKER & CO., PUBLISHERS,

1902.

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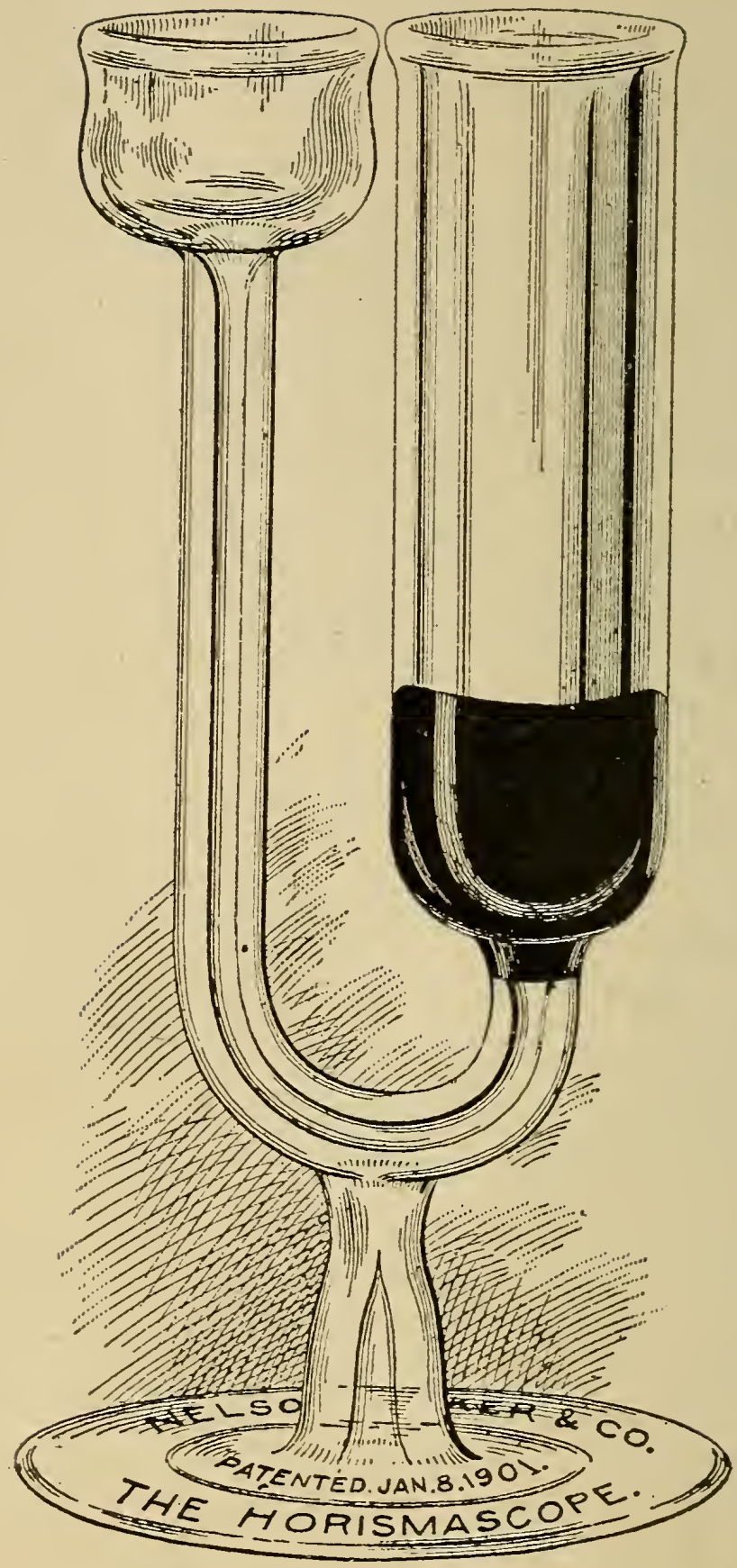
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THE HORISMASCOPE.

ROUTINE FOR EXAMINATION OF A SPECIMEN OF URINE.

1. Observe the **physical characters** of the specimen, noting particularly its color and odor, and the presence or absence of any visible deposit.

2. Test the specimen for **acidity** with a slip of blue litmus paper, for **alkalinity** with red litmus paper. If the latter be turned blue, dry it. The blue color is retained if a fixed alkali is present; if the red color returns, the alkalinity is due to ammonia. Urine normally is acid.

3. Determine the **specific gravity** of the urine. This is most conveniently done by aid of a urinometer. Remember that temperature affects the specific gravity. If the temperature of the specimen be above 60°F., add to the reading of the urinometer 0.001 for each eight degrees in excess of 60. Thus if the reading be 1.017 on a warm day in summer, the temperature being near 84°, add 0.003, making the corrected specific gravity 1.020.

An abbreviated urinometer, much less fragile than the ordinary instrument, and having only a

single mark corresponding with a specific gravity of 1.005 may be employed when great exactness is not required. In most cases the urine will be of a higher specific gravity than this, the instrument floating so that the mark is quite above the level of the liquid. Add to half a fluidounce of the urine, carefully measured, an equal volume of water and test once more. If the mark is still above the surface, add to the mixture half an ounce more of water, and continue to test thus until water enough has been added to bring the mixture to such a density that the mark will coincide with the surface of the liquid. Reckon for each half-ounce of the final volume of the fluid .005 to be added to unity for the specific gravity of the original urine. Thus if 2 1-4 fluidounces of water have been added, making the volume 2 3-4 fluidounces, the .005 must be multiplied by 5 1-2, giving as the required specific gravity 1.027. The usual correction for temperature must be made as already explained.

The last two figures in the specific gravity may be taken as approximately the number of grains of total solids to the fluidounce. More exactly, these figures multiplied by the coefficient of Haeser, 2.33, will give parts per thousand (grams per liter) of solids. In normal urine one half of the total solids, thus estimated, may be assumed to be urea.

4. Test to determine whether **urea** is present in normal amount. Place on a glass slide a drop of

the urine and add a drop of strong nitric acid. Crystals of urea nitrate form rapidly in dense urine, only after some time in urine of low specific gravity. Judge by the amount of crystallization the quantity of urea present.

5. Test for **Sulphates.** Add to 60 minims of the urine in a test tube first a few drops of hydrochloric acid, then a few drops of a solution of barium chloride (1:20). A finely divided white precipitate of barium sulphate is thrown down. If the test is made in the tube of a centrifuge, the quantity of barium sulphate may be quite accurately read off after whirling, and it can be seen thus whether the sulphates are present in normal proportion.

6. Test for **Phosphates.** (a) Total phosphates. Put into a test tube four fluidrachms of the urine, add 30 minims of magnesia mixture (magnesium sulphate, 1 part; ammonium chloride, 1 part; water of ammonia, 1 part; water, 8 parts); the precipitate of magnesium phosphate should render the mixture milky white throughout in a normal urine. The quantity may be estimated by aid of a centrifuge. Instead of magnesia mixture, we may use uranium acetate for the precipitation.

(b) Earthy phosphates. Put into a test tube four fluidrachms of the urine, add 10 minims of water of ammonia, warm and set aside a few minutes. The precipitate of calcium and magnesium phosphates should occupy one-sixth to one-eighth of the volume of the fluid. The precipitate may be

collected on a filter, washed with water containing ammonia, dissolved in acetic acid and precipitated with uranium acetate, and the amount of precipitate then observed by aid of the centrifuge, for more exact quantitative results.

7. Test for **Chlorides.** Place in a test tube 60 minims of the urine and add a few drops of pure nitric acid, then a few drops of a solution of silver nitrate 1:25. A heavy curdy precipitate should be produced. If the chlorides are diminished the fluid is simply rendered milky, the silver chloride collecting in flakes only after some time or not at all. The quantity of chlorides may be quite accurately determined by measuring the volume of the precipitate after whirling in the centrifuge.

If albumin is present, it must be removed by boiling with a little acetic acid and filtering before testing for chlorides.

8. Test for **uric acid.** To two fluidounces of the urine add half an ounce of ammonium chloride, dissolve and set by in a cold place two hours. The uric acid will be thrown out of solution in combination with ammonia, and the amount may be judged by the volume of the precipitate, especially if a portion is whirled a few minutes in a centrifuge. Exact determination of the uric acid may be made by collecting the precipitate (from 100 c. c. of urine) on a filter, washing three times with a saturated solution of ammonium chloride, washing from the filter with a jet of hot water, heating to boiling

with hydrochloric acid: after two hours standing in the cold collecting the uric acid, dissolving in warm sodium carbonate solution adding 20 c. c. of strong sulphuric acid and titrating the warm solution with potassium permanganate, one twentieth normal. For each c. c. of the volumetric solution consumed, reckon 3.75 mg. uric acid.

9. Test the specimen for **albumin.** (a) Apply first **Tanret's test,** the double iodide of mercury and potassium. If this gives a negative result, albumin is certainly absent and the other tests for albumin may be omitted. A precipitate or cloudiness may, however, be produced in absence of albumin, caused by other proteids, by alkaloids or possibly by urates or mucin. Heat the mixture containing the precipitate; if it remain undissolved, it consists probably of albumin. Confirm by other reagents, particularly potassium ferrocyanide.

MODE OF MAKING THE TEST.

Tanret's reagent is made by dissolving in 12 fluidounces of water 289 grains of potassium iodide and 118 grains of mercuric chloride (corrosive sublimate) and adding 4 1-2 fluidounces of acetic acid. If tablets are used, dissolve one potassio-mercuric and one citric acid tablet in 30 minims of water. Put into a test tube a fluidrachm of the urine, which, if not perfectly clear should be made so by filtration and add a little of the reagent, allowing it to flow down the side of the tube. If a precipitate forms, heat to boiling, when the precipitate, if not

due to albumin, will generally clear up, to return on cooling.

Use of **Horismascope.** The test may be advantageously made in the horismascope. In this case dissolve in the reagent prepared as above one of the large tablets of sodium sulphate to increase its density. Put into the horismascope two fluidrachms of the clear urine. Incline the instrument so that the fluid will rise to the very top of the narrow tube, without overflowing into the funnel. Then pour into the funnel about 30 minims of the reagent which will flow down the small tube and form a layer underlying the urine. At the plane of contact between the strata of fluid there will form at once a milky ring very distinctly seen against the dark background of the instrument. A minute trace of albumin will in this way be easily detected. Remember, however, that the cloud may be due to something besides albumin, and proceed to apply confirmatory tests for albumin. Remember also that the solution containing a large amount of sodium sulphate may not clear up on heating even if the precipitate is not one of albumin.

(b) As a confirmatory test, use **potassium ferrocyanide** since this reagent produces no precipitate unless albumin is present. It will detect one part of albumin in 12,000 of fluid, being therefore a much less sensitive reagent than the last mentioned. Dissolve a ferrocyanide and a citric acid tablet in 30 minims of water and add 15 minims of the clear

urine. Do not boil, as this reagent is decomposed by heat. The test may be made in the albumoscope, one of the tablets of sodium sulphate having been dissolved in the reagent to give it the requisite density.

(c) Many physicians will prefer to use **nitric acid** as a confirmatory test. Heller's modification of the test is the best for ordinary use, and may be made conveniently in the horismascope. Put into the instrument two fluidrachms of the urine rendered clear if necessary by filtration. Tilt the instrument so that the fluid will completely fill the small tube, otherwise the air in the tube may prevent the acid from flowing into it. Pour into the funnel 20 or 30 minims of strong nitric acid which will flow down and form a layer underlying the urine. If albumin is present a white ring will form at the plane of contact of the fluids, very distinctly seen against the black background. The characteristic color produced by the action of the acid on the coloring matter of the urine will also be well seen against the background of white.

A hazy ring forming slowly a little distance above the plane of contact is likely to consist of acid urates. In such case if the turbid fluid is transferred by a pipette to a test tube and warmed, it clears up. A cloud may be produced by oleo-resins, which differs from that due to albumin in that it is cleared up on addition of alcohol.

The **quantity** of albumin present may be judg-

ed by the appearance of the white ring or zone. If this is only faintly white without granular appearance, having a depth of less than 4 mm. (1-6 inch) the quantity does not exceed one fourth of one per cent. If the zone is opaque white slightly granular and 4 to 6 mm. (1-6 to 1-4 in.) in depth, the quantity is as much as 1-4 to 1-2 per cent. When the quantity is greater than this the zone is distinctly flocculent and even curdy in appearance.

Further details regarding the nitric acid test will be found in any treatise on urinalysis. The test by boiling is also too well known to require repetition here.

(d) **Acidulated brine** constitutes a useful test readily made by aid of the horismascope. The reagent consists of a saturated solution of sodium chloride [common salt answers every purpose] to which has been added five per cent of diluted hydrochloric acid U. S. P. Very similar to this is the nitric-magnesian fluid of Dr. Roberts which is prepared by adding to a cold saturated solution of magnesium sulphate one fifth of its volume of strong nitric acid. This is used precisely in the same manner as nitric acid, and is particularly well adapted for use in the albumoscope. Peptones, however, as well as albumin may be precipitated by this reagent.

(e) **Picric acid** forms a very delicate test for albumin, although, like Tanret's reagent it precipitates some vegetable alkaloids, oleo-resins, etc.

Heat redissolves all but the albumin precipitate.

(f) **Sodium Tungstate** as a reagent for albumin is nearly as sensitive as the potassio-mercuric iodide. It precipitates peptones, but heat redissolves the precipitate. In using the tablets of picric acid or sodium tungstate follow the directions given under (a). Another method of procedure, applicable with any of these tablets is the following: Add to 30 minims of the urine a citric acid tablet and shake until dissolved. A cloudiness may be produced by mucin, by uric acid, or sometimes by oleo-resins, as where balsam copaiba has been taken medicinally. On heating the urine clears again except where mucin is present. To the urine, cleared if necessary by filtration, the albumin precipitant is then added, the tablet having been first dissolved in a little water.

(g) **Spieglers' Albumin Reagent** consists of corrosive sublimate, 20 grs.; tartaric acid, 10 grs.; distilled water, 1 fluidounce; pure glycerin, 40 minims.

(h) **Millard's Albumin Reagent** consists of carbolic acid, 2 fluidrachms; glacial acetic acid, 7 fluidrachms; liquor potassae, 3 fluidounces.

(i) **Fouchlos** uses the following reagent: potassium sulphate, 40 grs.; water, 6 fluidrachms; acetic acid, 80 minims

(j) **Jolles' Reagent** consists of corrosive sublimate, 10 grs.; sodium chloride, 10 grs.; succinic acid, 20 grs.; distilled water, 1 fluidounce. Mix 30 minims of the urine with 15 minims of acetic

acid, add 60 minims of the reagent and shake. In another tube mix 60 minims of the urine with 15 minims of acetic acid. The most minute traces of albumin are detected with certainty by this reagent. Of course the contents of the second tube should remain clear. Otherwise the result of the test remains in doubt.

The **quantity** of **albumin** present may be quite accurately determined by adding to 6 c. c. of the urine a solution made by dissolving in 4 c. c. of water one picric acid tablet and one citric acid tablet. The mixture is whirled in a centrifuge at low speed three minutes, when the quantity of precipitate may be read off. Reckon for each c. c. of precipitate 0.2 per cent. by weight of albumin.

10. If in applying tests for albumin there have appeared indications of the presence of **peptones**, a special test should be made for these as follows: Place in the horismascope two fluidrachms of the urine, pour into the funnel tube 30 minims of Fehling's solution and set the instrument by for a few hours. If peptones are present, a violet color develops at the plane of contact of the fluids extending upwards into the urine which ultimately (perhaps after two days) becomes tinged throughout. This is known as the biuret test and the reaction is very characteristic. If albumin is present, it must be removed by boiling (after addition of a little acetic acid) and filtering before testing for peptones.

11. Test the urine for **Sugar.**

(a) Apply **Mulder's test** which consists of indigo carmine associated with sodium carbonate. The reagent is prepared by simply dissolving one of the indigo carmine tablets in 60 minims of water. The solution is heated to the boiling point, one drop of the urine is added from a pipette and the solution kept just at the point of ebullition, but not permitted to boil for 60 seconds. If no change is produced add another drop of urine and heat again 60 seconds. If sugar is present in abnormal quantity the color of the solution changes from pure blue to violet then successively to red, orange and finally a pale straw color. If the quantity of sugar be small, the final pale color may not be reached. If the tube be shaken so that the fluid comes in contact with oxygen from the air, the original blue color is rapidly restored.

Remember that normal urine contains a reducing agent which will produce the changes of color described if a larger quantity of urine (from five to ten drops) be used. If sugar is present in quantity to indicate a pathological condition, two drops will produce the change at least to red.

If one drop of urine is used, the series of color changes will be complete in 30 seconds when the urine contains 35 grains or more of sugar to the fluidounce, in 60 seconds when the quantity present is 10 grains, in two minutes when it amounts to 5 grains. If at the end of two minutes the color is

reddish yellow the quantity is 4 grains, if red, three, if purple, two, if violet one grain to the fluidounce. In urine containing more than 10 grains of sugar to the ounce, the quantity can be best determined by diluting until a single drop reduces the indigo completely in 60 seconds. The diluted specimen may be assumed then to contain 10 grains of sugar to the fluidounce.

b. If **Methylene blue** is substituted for indigo carmine, the presence of glucose will be indicated by simple decoloration of the solution, the color being restored as in the case of indigo by shaking the fluid so that it will come in contact with the oxygen of the air. **Litmus blue** is also decolorized in alkaline solutions by boiling as is **safranin**, a red coloring matter. In each case the loss of color is due to deoxidation. The same is true again of the loss of color of a freshly prepared solution of **potassium ferricyanide** (red prussiate). This test may be made a very delicate one in the following manner. Dissolve a grain of the red ferricyanide in 30 minims of water, add ten minims of liquor potassæ and a single drop of the urine. Heat the mixture to boiling, add hydrochloric acid in slight excess and then a drop of a solution (1:50) of ferric chloride, free from ferrous salt. If sugar is present, a blue precipitate will be thrown down.

c. Apply the **Copper test** for glucose, in the following manner (method recently published by Dr. A. B. Lyons). Put into a test tube 30 minims

(measured) of the urine with one copper test tablet, one fourth of a citric acid tablet and two sodium carbonate tablets. Heat to boiling and boil one minute. If much sugar is present there will probably be thrown down a deposit of red cuprous oxide, but whether this appear or not, add to the solution a few drops of dilute hydrochloric acid, just sufficient to render it acid, making it also transparent. Add four fluidrachms of water, then a few drops of a solution (1:20) of potassium iodide. If sugar is present a white precipitate is thrown down. Normal urine will always reduce a certain amount of copper, so that if the water is not added a distinct precipitate will be thrown down, but this will be sufficient only to produce a slight turbidity in the dilute solution. If the urine contains as much as 0.25 per cent. of sugar (about 1 grain to the fluidounce), the dilute fluid will be strongly clouded.

The test may be modified by substituting for the citric acid about 1-8 grain sodium salicylate. If the urine is strongly acid it may be necessary to use more than one tablet of sodium carbonate; one will generally suffice when sodium salicylate is used in place of the citric acid.

Another method of making the test is to put in a test tube 30 minims of a dilute Fehling's solution —the ordinary Fehling's solution diluted with 5 to 8 times its volume of water, so that it is of a pale blue color—add 5 drops of the urine, boil one minute, render acid with hydrochloric acid and

without diluting add two drops of a clear solution of potassium iodide. If sugar is present in the proportion of 2 grains to the fluidounce, a distinct precipitate will be thrown down. If a heavy precipitate is produced, repeat the experiment using only one drop of the urine. If turbidity is produced in this case by adding the potassium iodide, the quantity of sugar exceeds 5 grains to the fluidounce. When there is as much sugar as this present, it will be generally detected by precipitation of cuprous oxide if the dilute Fehling's solution is employed with not more than four or five drops of the urine.

d. Apply **Dr. Johnson's picric acid** test. Put into a test tube 30 minims of the urine, add one tablet of picric acid and 15 minims of liquor potassæ, U. S. P. and boil one minute. The color is always darkened, but if sugar is present is changed to a deep red brown. Prepare a color standard by dissolving in a mixture of 5 fluidrachms of water and two fluidrachms of diluted sulphuric acid, U. S. P., 22 3-4 grains of potassium bichromate. Dilute the brown fluid obtained in the test with water until it is as nearly as possible of the same tint as the standard. Measure the solution, deduct five fluidrachms for "normal sugar", and reckon for each fluidrachm of the remainder 0 06 grain of sugar to the fluidounce. For this simple and practically exact method of determining sugar quantitatively in urine we are indebted again to Dr. A. B. Lyons.

If the results obtained coincide with those of the copper test described above, there can be no question of their substantial truth.

e. Some physicians prefer to rely upon the **Bismuth test**, which, in any case, may be made in confirmation of the preceding. Put into a test tube a fluidrachm of the urine, add 15 minims of liquor potassæ, U. S. P. and a tablet of bismuth subnitrate and boil at least one minute. If sugar is present, the bismuth assumes a dark color, becoming quite black when the quantity is large. Sulphur will also blacken the bismuth, and this element is present In albuminous urine. In case there is a darkening of the bismuth, therefore, boil another sample of the urine with a tablet of lead carbonate and some liquor potassæ. If the lead is darkened, sulphur is present, and the result of the bismuth test must be regarded as valueless.

In all tests for sugar, make sure that albumin is absent. Should there be albumin in the urine, coagulate it by boiling with a few drops of acetic acid and remove by filtration before testing for sugar.

f. The tests hitherto described are all faulty in that other substances besides sugar may produce the same reactions and such substances (as e. g. uric acid) are known to be present even in normal urine. There is one test practically free from this objection. **Phenyl-hydrazin** reacts with sugar to produce a nearly insoluble compound, and so serves

as a specific test for sugar.

The test may be made thus (Allen): Heat to boiling four fluidrachms of the urine, add 2 fluidrachms of a solution of lead acetate (1:10); boil and filter hot. Add sufficient solution of caustic soda to redissolve the precipitate which forms at first, then as much phenyl-hydrazin as will lie on the point of a pen knife and boil the mixture for some minutes and then make acid with acetic acid. If much sugar is present an immediate yellow turbidity is produced. Traces of sugar are shown by a yellow coloration, the solution generally becoming turbid on standing.

The use of Pavy's, Fehling's and Knapp's solutions for quantitative determination of sugar in the urine will be found in the larger text books on urine analysis, as will be also details of the fermentation test.

g. The **horismascope** may be used in testing for sugar in the following manner Place in the instrument a mixture of 20 minims of Fehling's solution with two fluidrachms of water. Pour into the funnel tube a mixture of 15 minims of the urine with 15 minims of clear saturated solution of common salt, and let the instrument stand over night.

If much sugar is present, red cuprous oxide will deposit at the plane of junction of the fluids, a portion of it settling at last to the bottom of the tube. This is a good confirmatory test of the presence of sugar, but does not detect with certainty mere

traces of that substance.

12. Test the urine for **Indican** by mixing 20 minims of it with a fluidrachm of strong hydrochloric acid. In normal urine only a reddish color is developed. If indican is present in excess, the color is violet or distinctly blue. The test may be made in the horismascope in the following manner. Place in the instrument two fluidrachms of the urine. Pour into the funnel tube a mixture of 30 minims of strong hydrochloric acid with one minim of a ten per cent. solution of potassium nitrate. The colors produced are the same as above. **Jappe's** test is made by adding to two fluidrachms of the urine an equal volume of hydrochloric acid and 30 minims of pure chloroform, then adding drop by drop a freshly prepared solution of chlorinated lime, shaking after each addition. If indican is present in excess, the chloroform assumes a violet or blue color, which fades when an excess of chlorinated lime is added.

13. Test for **Bile Pigments.** Put into an horismascope a mixture of 30 minims of nitric acid with 30 minims of the urine. Pour into the funnel tube 30 minims of strong sulphuric acid. The presence of bile pigments is shown by the appearance of a grass green ring at the plane of contact of the fluids. This is known as **Fleicht's test** and is altogether the most delicate test we have for bile pigments, provided these are not already oxidized.

Another method of making the test is to place

in the horismascope two fluidrachms of hydrochloric acid to which has been added just enough of the urine to color it distinctly, then to pour into the funnel tube 30 minims of strong nitric acid. The characteristic colors, produced just above the plane of contact, are vividly developed.

14. Test for **Bile Salts**, Evaporate two fluidounces of the urine on the water bath to dryness. Extract the residue with about 90 minims of alcohol, filter and add 2 fluidounces of ether. Collect the scanty precipitate which forms after a time on a filter, wash it with ether, dissolve it in 20 minims of pure water. Add to this solution one drop of a mixture of simple syrup with four times its volume of water, transfer to the horismascope and underlay it with strong sulphuric acid. The presence of bile acids is shown by a purple-red color, but the test often fails even in experienced hands.

Dr. Oliver's test consists of a solution of peptone, 4 grains and acetic acid 4 minims in a fluidounce of water. The reagent is placed in an horismascope and 30 minims of the urine is poured into the funnel tube. If bile salts are present, a milky zone develops. Normal urine may show the reaction very faintly.

15. Examine the **Deposit** if any, in the urine. If little or no deposit is noticeable in the specimen, put a portion of it into the tube of a centrifuge and whirl a few minutes, when the deposit will be found concentrated at the bottom of the tube.

DIAGNOSIS OF THE DEPOSIT.

a. It is **amorphous**, i. e. the particles show no definite shape under the microscope. 1. If the deposit is bulky and of a tawny color it probably consists of **urates**. In this case it will redissolve if the urine containing it is heated moderately. If a portion of the deposit is dissolved in a few drops of hot water, a drop or two of acetic acid added and a drop of the mixture is placed on a slide under the microscope, crystals of uric acid will presently separate, recognized by their shape and by chemical tests. 2. If the deposit is bulky and nearly white, it probably consists of **earthy phosphates**. The urine will be found to be alkaline or neutral, and on adding a few drops of acetic acid, the deposit will dissolve. Generally there will be crystals also present of the so called triple phosphate. To prove that the deposit consists of phosphate, collect on a filter, wash once with water, dissolve by aid of a little acetic acid and add solution of uranium acetate, which will throw down a yellowish precipitate.

b. The deposit is **crystalline**. In most cases the crystals will be recognized at once under the microscope. The most common forms are 1. The large prisms or snowflake-like stars of **tripie phosphate;** 2. The minute octahedra or, less commonly, the dumbell forms characteristic of **calcium oxalate**. The deposit may be granular rather than distinctly crystalline, and is then distinguished from earthy phosphates by the fact that it is insoluble in

acetic acid, but dissolves in hydrochloric acid; 3. **Uric acid**, consisting generally of reddish grains (brick dust), occasionally nearly colorless, exhibiting a great variety of shapes, yet generally recognized without difficulty. They do not dissolve in acids of moderate strength, but are quickly dissolved by liquor potassæ, being reprecipitated in characteristic shapes by adding acetic acid in excess. 4. **Urates**, which are also soluble in potassa, and reprecipitated as uric acid by acetic acid. Besides these, crystals of **Cystin, Leucin** and **Tyrosin** are occasionally met with and readily recognized by the microscope and by characteristic chemical reactions.

c. **Organized Deposits.** These include 1. **Epithelial cells;** 2. **Blood corpuscles;** 3. **Mucus and pus cells:** 4. **Tube casts** from the kidneys; 5. **Spermatozoa**, the recognition of which is a simple matter to the experienced microscopist.

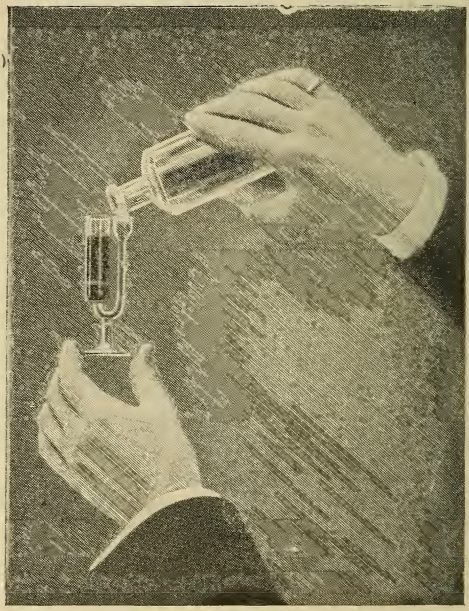
THE HORISMASCOPE

Was devised originally to render more easy and certain the detection of albumin in urine. The name Albumoscope was therefore given to it, and under this name it has become widely known to physicians. The instrument enables the operator to apply a reagent of high specific gravity, like nitric acid, in such a manner that it shall underlie the fluid tested, the plane of contact between the two fluids being thus sharply defined. The name Horismascope, derived from the Greek, implies that the instrument is for the examination of this "boundary" between two fluids.

DIRECTIONS FOR USE.

In testing urine for albumin with nitric acid, fill the large tube of the Horismascope two thirds full of the urine, which must be made perfectly clear and transparent if necessary by filtration. Then pour into the funnel tube 25 or 30 minims of nitric acid, which will pass down through the capillary tube and form a layer underlying the urine. If albumin is present, a distinct white zone will presently appear at the point of contact, sharply defined against the black background, the amount of albumin being indicated by the density of the opaque ring. Sometimes air will remain in the capillary tube of the instrument preventing the acid from running down the tube. It is always best to see that the tube is free from air before pouring in

the acid. If air is present it can generally be driven out by merely tilting the instrument or it may be driven down the tube by placing the thumb



or middle finger on top of the funnel so as to cover it completely and pressing quickly and forcibly so as to cause a few bubbles of air to pass through the urine.

L. of C.

In the use of the Horismascope in applying the nitric acid test for albumin, the following advantages are secured.

1. The acid where it comes in contact with the urine is of full strength rendering the test much more delicate than as ordinarily applied.

2. The reaction is not liable to be obscured by separation of uric acid or urates, such separation not taking place in the Horismascope until after a considerable interval.

3. The black and the white backgrounds of the instrument render much more distinct the effects produced by the reagent.

4. No especial skill is required on the part of the operator.

The faintest visible trace of albumin as shown by the nitric acid test may be stated to be 1-60 per cent. One-fourth of one per cent. is just sufficient to make the albumin layer opaque when viewed from above. If larger amounts are present the percentage may be approximately estimated by diluting the urine until the opacity is reduced to that corresponding with 0.25 per cent.

There are many other tests which can be advantageously made by introducing the reagent from beneath, allowing it thus to form a distinct stratum underlying the fluid to be tested. The more important of these have been noticed in the foregoing pages.

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